

Applicant : Chih-Chien Liu
Appl. No. : 09/991,196
Examiner : Sergeant, Rabon A.
Docket No. : 20952.4003

REMARKS

Claims 21-29, 31-32, 35, 40-44, 46, 48-50, 52-54, 56 and 58 are pending in this application. Independent claims 21, 35 and 40 are amended. Reexamination and prompt allowance are respectfully requested.

I. Formalities

Applicants respectfully request that the attorney docket number for the application be changed from Docket No. UMC-96-279 CON2 to Docket No. 20952.4003.

II. Rejection under 35 USC § 112

Claims 35 and 50-53 are rejected under 35 USC § 112, second paragraph, as "being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention." Applicants amend claim 35 to address this rejection.

III. Amendments to Independent Claims 21, 35 and 40

Claims 21, 35 and 40 are amended to incorporate the limitations of previously dependent claims so that the independent claims recite that the conductive protective layer is titanium nitride. The corresponding dependent claims are canceled.

Claims 21 and 35 are amended to reword a number of their limitations. These amendments are not discussed here as they were present in the previous text of claims 21 and 35, respectively.

Claims 21, 35 and 40 are amended to further emphasize the HDPCVD process described in the application for depositing a dielectric layer for gap fill in which initial layers as indicated by 38 in FIG. 3 are formed to cover exposed portions of the sides of the wiring lines. These amendments find support in FIGS. 3 and 4 and in the application at page 12, lines 16-30.

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IV. Rejections under 35 USC §103

The Office Action rejects independent claims 21 and 35 over Japanese patent publication 8-288285 in view of U.S. Patent No. 5,854,126 to Tobben, et al. As discussed below, the cited references wholly fail to disclose or suggest the claimed invention. Moreover, the Office Action's rejection ignores the explicit statements of the '285 publication teaching away from the use of a photoresist mask for etching wiring lines, which is precisely what is recited in the pending claims.

The Office Action rejects the third of the pending independent claims, claim 40, over the '285 publication further taken in view of a catalog of references: U.S. Patent No. 4,172,005 to Muraoka, et al., U.S. Patent No. 5,127,989 to Haraguchi, et al. or U.S. Patent No. 5,316,640 to Wakabayashi, et al. None of these references has anything to do with tailoring the performance of high density chemical vapor deposition or at all influencing any type of dielectric deposition process. Rather, the catalog of references is plainly selected solely by reference to the pending claims.

The Office Action Ignores the Recitation in the Prior Claims that Photoresist is used in Etching the Wiring Lines; The Current Claims Distinguish Over the Cited Art by Reciting Use of Photoresist in Etching Wiring Lines

The current claims, as well as the previously pending claims, recite the use of a mask including photoresist in the etching used to define the wiring lines. For example, claim 21 recites in pertinent part "the first mask comprising a patterned photoresist layer" and "etching the wiring layer using the first mask to form wiring lines separated by gaps." As discussed in the present application at page 10, lines 20-24, use of a photoresist mask can be simpler and consequently cheaper than a hard mask process. This stands in contrast to the '285 publication, which teaches that use of photoresist results in poor step coverage: "the wiring layer does not need a resist mask. Accordingly, there is not an apprehension that the residues resulting from the resist mask remain on the sidewalls and so forth of the wiring patterns. Therefore, there is not a possibility that the step coverage of the planarized insulating film deteriorates due to

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the residues, or the wiring patterns corrode due to chlorine system compounds or chlorine system gas absorbed by the residues.” ‘285 publication at ¶ 16.

It appears that the Office Action appreciated these teachings of the ‘285 publication. Specifically, the Office Action states at page 3: “The reference further discloses steps wherein the mask layer is patterned, the cap layer is etched according to the mask layer pattern, *the mask layer is removed, and the wiring line is etched according to cap layer pattern*” (emphasis supplied). The Office Action appreciated that the ‘285 publication **does not** etch the wiring lines using a photoresist mask and **instead** uses the cap layer as a hard mask. Accordingly, the Office Action incorrectly rejected the prior independent claims. The currently pending claims distinguish over the ‘285 publication by reciting the use of a mask including photoresist for etching the wiring layer to form wiring lines.

Claim 21 is quoted in pertinent part above and shows that claim 21 distinguishes over the ‘285 publication. None of the other references suggest altering the hard mask teachings of the ‘285 publication and so claim 21 and its dependent claims distinguish over the art of record and are in condition for allowance. Claim 35 recites, “the first mask comprising patterned photoresist; etching the cap layer, the conductive protective layer and the wiring layer using the first mask for etching the cap layer, the conductive protective layer and the wiring layer.” Consequently, claim 35 and its dependent claims distinguish over the art of record and are in condition for allowance. Similarly, claim 40 recites, “patterning the wiring layer to form wiring lines separated by gaps using a patterned portion of the photoresist layer as a mask for etching the cap layer and the wiring lines.” Claim 40 and its dependent claims distinguish over the art of record and are in condition for allowance.

The Claims Distinguish Over the Cited Art by Reciting that Initial Layers of the Dielectric Material Cover Exposed Side Portions of the Wiring Lines

As shown in application FIG. 3, initial layers of the dielectric material 38 are formed to cover the sidewalls of the wiring lines exposed during etching of the wiring

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layer. This is reflected in, for example claim 21, which recites “an initial stage of the depositing forming initial layers of the dielectric material over the substrate, covering the exposed side portions of the wiring lines and on at least portions of the remaining portions of the cap layer.” The process illustrated in FIG. 3 of the present application protects the wiring lines and avoids contamination of the interwire dielectric with conductive material.

The structure recited in claim 21 is not formed in the process described in the ‘285 publication. This is most readily illustrated by the process steps at ‘285 publication ¶ 42 cited by the Office Action at page 5, in which layer 8 is deposited using ECR plasma CVD and layer 9 is deposited with conventional CVD using ozone TEOS source gases. Layer 8 is deposited to a thickness of 300 nm, which is too little to fill the gaps between the wiring lines and leaves the wiring lines exposed on the sides following depositing layer 8 using ECR plasma CVD. Consequently, claim 21 distinguishes over the paragraph 42 disclosure of the ‘285 publication.

The ‘285 publication also describes depositing a film 7 using ECR plasma CVD so that the film 4a is subjected to sputtering to intentionally remove portions of the layer 4a. Due to the intentional sputtering of the layer 4a, none of the layer 7 will be initially deposited on the layer 4a. Because of this, the ‘285 publication’s description of the layer 7 deposition does not meet claim 21’s recitation that “an initial stage of the depositing forming initial layers of the dielectric material ... on at least portions of the remaining portions of the cap layer.” Nor would the ‘285 publication’s deposition of layer 7 provide an initial layer that covers the exposed sidewalls of the wiring lines, because of the high level of sputtering performed at the initial stage of depositing layer 7.

None of the references of record describe or suggest a dielectric deposition process as defined in claim 21 by its recitation “an initial stage of the depositing forming initial layers of the dielectric material over the substrate, covering the exposed side portions of the wiring lines and on at least portions of the remaining portions of the cap layer.” Claims 35 and 40 have similar recitations and so similarly distinguish over the

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'285 publication, whether taken alone or in combination, and are in condition for allowance.

At page 4, the Office Action suggests that the deposition process described in the '285 publication "inherently" meets the limitations of the prior claims. As discussed above here, there is no reason to think that any of the processes described in the '285 publication would meet the limitations of the pending independent claims. The Office Action has failed to establish the propriety of relying on "inherency," has failed to establish a *prima facie* case of unpatentability, and has failed to establish the unpatentability of the pending claims. As such, applicants request the prompt allowance of the pending claims.

The Office Action Misreads Paragraph 42 of the '285 Publication and Cites Irrelevant References in Support of Its Rejection of Claims 24-27, 40-44 and 54-56.

In rejecting claim 40 and a number of other of the pending claims, the Office Action refers to paragraph 42 of the translation of the '285 publication. That paragraph describes that the layer 4a has its edges etched (by sputtering) during the plasma-mediated deposition of layer 8 to improve the ***non-plasma-mediated, conventional chemical vapor deposition*** of ***ozone-TEOS*** (including its semi-liquid flow properties) to form layer 9. '285 publication at ¶ 42. That is, accepting fully the Office Action's statement that the '285 publication describes an HDPCVD process for depositing layer 8, the '285 publication ***does not suggest*** that having tapered edges ***has any benefit*** for HDPCVD processes. Rather, paragraph 42 of the '285 publication teaches that it is useful for cap layer 4a to have tapered edges for ozone-TEOS, conventional CVD processes. Moreover, the '285 publication ***never describes*** a process in which a tapered edge of a cap layer is provided at the start of an HDPCVD process.

Consequently, the Office Action's citation of paragraph 42 of the '285 publication to support the proposition that "tapering layer 4a facilitates embedding of the insulating film" ***is wrong*** because "tapering layer 4a" is said to be advantageous for forming layer 9, which is not formed by an HDPCVD process. Layer 9 is formed from ozone-TEOS, which is a conventional CVD process without any plasma involved, much less high

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density plasma. The Office Action compounds its erroneous reliance on paragraph 42 of the '285 publication by citing, in the alternative, three different wholly irrelevant references as suggesting modification of the '285 publication's teachings. These citations cannot support the Office Action's section 103 rejection, as set out below.

None of the tertiary references cited by the Office Action have any apparent relationship to the processes defined in the claims pending in this application. The Muraoka patent describes a method for etching a silicon substrate as part of a process for forming bipolar integrated circuits. There is no suggestion in the Muraoka patent of using a shaped cap layer to enhance protection for a wiring line during an HDPCVD process. In fact, the ammonium hydroxide etching process that is taught in the Muraoka patent **could not be used** with the cap layer recited in the claims of this application.

The Haraguchi patent describes a method of using a shaped photoresist mask to form a shaped polysilicon layer 2. Here again, there is no suggestion that the Haraguchi patent's method would ever be used in a process like those set out in the pending claims. Specifically, there is no suggestion in the Haraguchi patent using a shaped cap layer to enhance protection for a wiring line during an HDPCVD process and so there is no reason that anyone of ordinary skill would modify either the primary or secondary reference in light of the Haraguchi patent. Moreover, there is no polysilicon layer (like that taught by the Haraguchi patent) used as any layer in the processes described in the present application. The Office Action's failure to identify any motivation or suggestion or even a rationale for making such a modification fails to meet the requirements for setting out a rejection under 35 U.S.C. § 103.

The Office Action's citation of the Wakabayashi patent is unjustifiable. The Wakabayashi patent is directed to forming microlenses and is unrelated to processes for forming integrated circuits. That is, the Wakabayashi patent is not analogous art. Moreover, the techniques described in the Wakabayashi patent are for shaping a gallium arsenide substrate and have no apparent application in the processes defined by the claims of the present application. Still further, there is no suggestion in the Wakabayashi patent of using a shaped cap layer to enhance protection for a wiring line

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during an HDPCVD process and so there is no reason that anyone of ordinary skill would modify either the primary or secondary reference in light of the Wakabayashi patent.

In addition to all of the reasons set out above as to why the rejection of claims 24-27, 40-44 and 54-57 is improper, the rejection is further improper because none of the tertiary references at all suggests altering the order of the processes described in paragraph 42 of the 285 publication. Even if the unworkable combinations of references were adopted, the resulting combination would still not create a "cap layer [that] is partially etched *prior* to the depositing to include slanted surfaces," (emphasis supplied) because the resulting combination would only etch cap layer 4a during plasma-mediated deposition of layer 8 and not prior to depositing layer 8.

The above discussions show that independent claims 21, 35 and 40 distinguish over the cited references for a number of reasons. The immediately preceding discussion illustrates that claims 24-27, 40-44 and 54-56 are improperly rejected and further distinguish over the art of record. For example, independent claim 40 further distinguishes over the cited art by reciting "wherein the remaining portion of the cap layer is partially etched prior to the depositing to include slanted surfaces."

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V. Conclusion


Prompt and favorable action on the merits of the claims is earnestly solicited. Should the Examiner have any questions or comments, the undersigned can be reached at (213) 612-2478.

The Commissioner is authorized to charge any fee which may be required in connection with this Amendment to deposit account No. 15-0665.

Respectfully submitted,

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